Lumber is under the gun from alternative products. How can lumber producers head them off at the pass?

Substitution

■ **By Henry Spelter**

Softwood lumber is a basic commodity whose price fluctuates according to demand and supply. Recent volatility and perceived high costs have led some lumber users to consider alternatives. How big a threat do substitutes pose for lumber and what can manufacturers do to head off such risks?

Let's start by putting the issue of lumber substitution in context. The most basic form of substitution is to use less of something by employing it more efficiently. This was the thrust of a set of proposals, titled "Optimum Value Engineering," made by National Assn. of Homebuilders engineers in the early 1970s in response to similar lumber availability and cost concerns. Among some of their prescriptions were:

- Using 2x4s @ 24 in. O.C. instead of @ 16 in. O.C. for load bearing wall framing.
- Using 2x3s @ 24 in. O.C. instead of 2x4s @ 16 in. O.C. for partition framing.
- Using 2x2s instead of 2x4s for closet framing.
- Eliminating joist bridging.

Though backed by sound engineering calculations, these and similar suggestions were not widely adopted. One reason why is that structural adequacy is not the only criterion by which structures are judged. Stiffness, or rigidity, is almost as important and, in the case of wood, is often the limiting design factor. If a building does not feel firm to its occupants, it will be regarded as flimsy.

This dovetails with another element in lumber marketing, namely, its quality. Wood is a natural material exhibiting considerable variability in its properties, a feature that has tended to get worse as second-growth timber, grown quickly over relatively short rotations, has become a bigger part of the timber supply.

In the South, when we consider the amount of wood harvested in recent years in relation to the stock of roundwood (i.e. trees with minimum diameter of 5 in.), the inventory turnover rate for most states is under 30 years and as low as 20 for some (Figure-l). Such timber yields different quality wood than old-growth. It's relatively small in diameter, knotty and coarse grained in texture, and contains considerable amounts of juvenile core wood which is weaker and more warp prone than mature wood. Its mechanical properties consequently exhibit great variability as displayed by a batch of recently tested no. 2, 2x10 southern pine lumber (Figure 2).

A more visible quality concern is dimensional stability. Southern lumber is generally dried so as not to exceed 19% moisture content, thus most of the lumber will continue to lose moisture and undergo dimensional changes after leaving the kiln. The resulting warp complicates its use: Builders must examine each piece and arrange them in an assembly so that the crowns of the warp face the same way opposite the load. Further, if floor sheathing is not glued or screwed down,

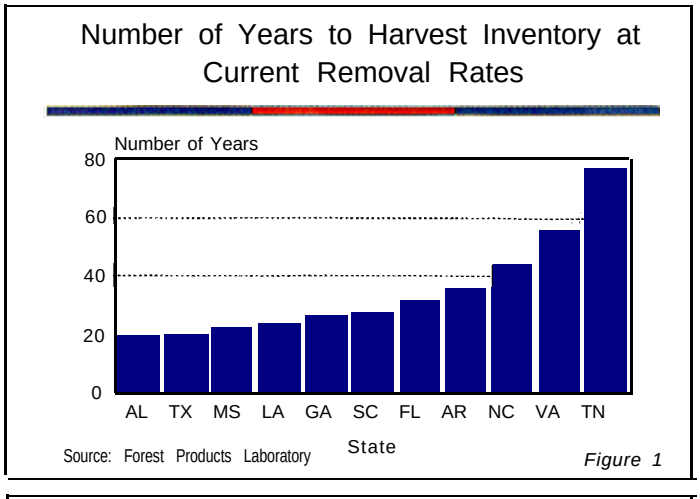

Figure 1

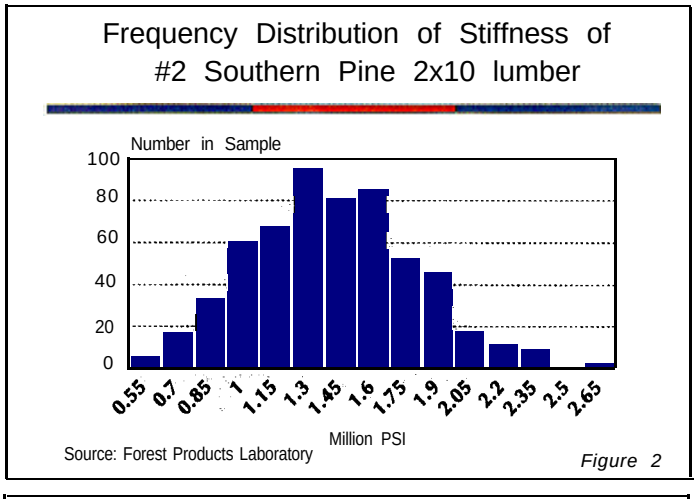

Figure 2

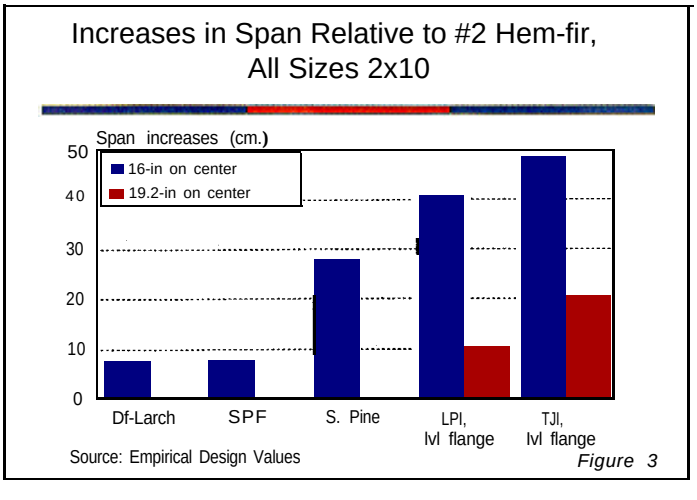

Figure 3

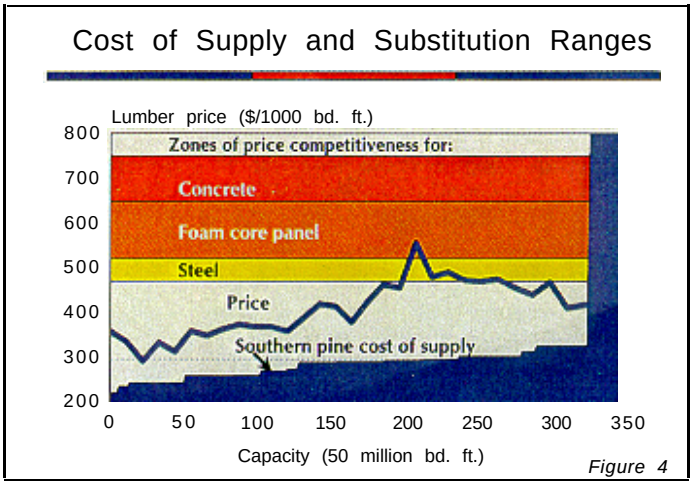

Figure 4

the dimensional changes in the framing may loosen nails. causing squeaking which could trigger a costly recall.

Complaints about quality are so common that they have almost a cliché'd quality, like complaints about the weather. But unlike the weather, this is something people can do something about.

The first option to users is alternative species. There are still large stocks of virgin timber available in the northern boreal forests of North America. While small in diameter, trees from these stands tend to exhibit greater dimensional stability and mechanical consistency than fast grown stands farther South. For example, random sampling under the in-grade testing program revealed less variability in spruce- pine-fir properties than in either southern pine or Douglas fir-larch (i.e. for stiffness in studs, 20% versus 27% and 24%, respectively. See Table 1). The substitution of northern for southern as well as western species, which are also increasingly sawn from short rotation, second-growth trees, has been an ongoing trend in North America over the last three decades.

The second level of substitution involves so-called engineered products, both wood (LVL, I-beams) and non-wood (steel). The producers of wood engineered commodities in particular have been the most aggressive in wielding the quality argument in favor of their products as these generally cost more. Among them are:

- Greater stiffness (bridging not required).
- Greater strength (allowing longer spans or wider spacing (Figure 3).
- Dimensional stability (eliminating squeaky floors and call-backs).
- Straightness (simplifying sheathing and cabinetry installation and eliminating sorting for crown).
- Longer lengths (no need to lap joists).

These claims imply that although up-front costs may be higher, overall in-place and lifetime costs are less, justifying the initial premium. That these claims have substance is supported by market share gains that engineered wood joists have made over the past decade. They are widely used to frame floors and some roofs where attic or living space is desired. Their prospects appear good and perhaps limited only by the availability of high strength wood because, in order to achieve their high mechanical properties, a supply of high quality timber is required. Fast grown plantation pine or low density hardwoods are not adequate with traditional veneered technology because their strength properties are low. Attempts to produce I-beams with flanges made from strand lumber technology, if successful, would break that potential bottleneck.

Steel's time in construction seemed to have arrived in the 1990s as high and volatile lumber prices caused builder dissatisfaction with existing materials. But as wood markets adapted and prices retraced, the steel marketing drive slowed. One possible explanation for this may lie in their marketing approach which emphasized costs, where their advantage was weak and temporary, at the expense of quality, where their advantage was more enduring.

Steel materials embody many of the same desirable characteristics of engineered wood. But. unlike engineered wood. steel is more difficult to fasten because metal does not spring back as wood fibers do when nailed and thus need more labor intensive fastening systems such as welds, bolts or screws. While steel is generally competitive when material costs alone are considered. its greater labor intensity makes its in-place costs higher than wood framing.

A third area of substitution comes

from the stressed skin, or insulated panel industry. Among its notable benefits are good insulation properties. Insulated panel walls and roofs create a nearly seamless, unbroken, thermal envelope, reducing heat loss through conduction and infiltration. They rely on structural panels to carry the load ordinarily borne by conventional framing. As a result, lumber use is reduced and limited to splines between panels and connecting plates at panel tops and bottoms.

The fourth area of substitution involves concrete. Concrete systems in housing have evolved from their basic function as only a foundation because today's insulated systems have overcome the traditional drawbacks of concrete (i.e. damp and cold). But they are also expensive. There are certain areas, however, where their basic properties make them appealing. For example, concrete is an excellent sound insulator. When the Interstate Highway system was designed, roads were typically routed around the outskirts of cities. Today, as those cities have spread out, many homes are being built next to noisy freeways. In those locations, concrete construction offers a way to deal with the noise problem.

Insulated concrete wall systems, like foam core panel systems, create exceptionally good insulation envelopes. Where high energy efficiency is desired, insulated concrete offers a competitive alternative.

Steel reinforced concrete is also strong. In many coastal, hurricane prone areas, a super strong structure could provide both peace of mind and insurance savings. Wood structures, too, can be designed for high-wind or earthquake resistance, but involve additional costs for plywood shear paneling and for hold-down hardware such as connectors, bolts and screws. These are typically not done unless mandated by code.

Some problems with insulated concrete systems from the builder's perspective include the pouring of the concrete because some of the polystyrene form systems are weak and prone to bulge or break under pressure. Considerable reinforcing is required to support the formwork during pouring and mistakes are costly because concrete, once it sets, is less forgiving than wood.

These are the main areas, then, where potential competition for lumber framing in general, and southern pine framing lumber in particular, exists. We analyze them in terms of in-place costs for structures built to similar insulation and wind resistance specifications. Figure 4 summarizes how they stack up in relation to each other and to the price of southern pine lumber.

The bottom area in the chart represents a schedule of the estimated average costs of supply for the southern softwood lumber industry in 1996, arranged by 20 subregions. The values represent a static picture of direct manufacturing costs based on 1996 timber costs prevailing in the regions as reported by Timber Mart South and state forestry departments, and labor and energy costs as reported by the Census (adding in overhead and depreciation would bump this schedule up by about $50 per MBF). The bands in the upper half of the figure represent the levels of lumber prices at which three lumber substitutes would become competitive. The white area represents a "comfort zone" for lumber, a region where prices are high enough to cover direct costs, but not so high as to invite outside competition.

Plotted over these is the 1995-97 price history of a standard grade of southern pine lumber. In June 1995, that price touched $300, which did not even cover variable costs for about one-third of the industry. Prices then recovered to the high 300s for the rest of the year and were at

Table 1. Stiffness and strength of lumber tested under the In-Grade program

Species & grade		Modulus of Elasticity (million psi)	(percent)	Modulus of Rupture (thousand psi)	(percent)
#2, 2x4	Pieces	Average	Coef of Var	Average	Coef of Var
S. pine	413	1.53	24	7.97	37
D.-fir-larch	386	1.56	27	8.01	34
S - P - F	440	1.34	22	6.66	35
Stud					
S. pine	657	1.45	27	7.17	37
D.-fir-larch	649	1.51	24	7.40	32
S - P - F	172	1.44	20	7.33	30

$365 in March 1996 when the U.S.-Canada lumber deal went into effect. This effectively raised the marginal cost of lumber by $100, and over the next six months framing lumber prices in general rose by roughly that amount. For a brief period, in November, the price spiked to $560. At that level, some substitutes became cost competitive outright. Had these prices persisted, the incentives for builders to experiment with alternatives would have been great. As it turned out, the lumber industry adjusted and increased supply in response to the higher incentives. Prices began a year long descent to around $440 in December 1997. But, in the meantime, milling costs also rose by about $50 due mostly to about a $70 increase in log costs, narrowing the comfort zone.

The implications of this for the lumber industry are clear. To operate in the long run, prices must at least cover direct expenses, but too high a price ($500 or so by our estimates) runs the risk of losing markets to competing products. Whether by luck or design, the initial effect of the U.S.-Canada lumber deal was to bump prices up, but to levels that generally stopped short of pricing the product out of its markets. With the higher price incentives, the U.S. lumber industry ramped up its output and prices retreated. But a fallout of the increased activity was higher log prices in the South. For the lumber industry, the latter development represented a move toward the least desirable scenario where rising input costs would push lumber costs to zones requiring prices so high that competing materials would become favored.

At another level, the industry needs to be mindful of the quality of its products. Meeting grade is of reduced value when others are redefining the standards. At the least, engineered wood-based products will capture market share if the industry can't match the value perceived in those products. Some factors, such as log size and quality, are not completely under a mill's control, but other items, such as wane, kiln drying and sorting for grade, are, and the benefits of historical strategies in these areas need to be weighed against their potential costs in reduced markets, TP

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